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(54) [Title of the Invention] DISPLAY DEVICE

(57) [Abstract]

[Purpose] To absorb electrostatic damage in a manufacturing process of a display device.

[Constitution] The display device has a panel structure provided with a drive substrate 1, a counter substrate, and an electrooptical substance layer held between both substrates. A pixel array portion 2 and a drive circuit portion are integrated on the drive substrate 1. The drive circuit portion is divided into a vertical drive circuit 3 and

a horizontal drive circuit 4. A conductive guard ring belt 5 is formed so as to surround the pixel array portion 2 and the drive circuit portion. Terminal portions 6 for external connection are provided outside the guard ring belt 5. Wirings 7 are formed so that the terminal portions 6 provided outside are connected to the drive circuit portion provided inside across the guard ring belt 5. The guard ring belt 5 includes small area portions 9 and a large area portion 10 which are electrically separated from each other by slits 8. The small area portion 9 is provided between the large area portion 10 and the wiring 7 and functions as a buffer region for electrostatic charge.

[Scope of Claims]

[Claim 1] A display device which has a panel structure provided with a drive substrate, a counter substrate, and an electrooptical substance layer held between both substrates; and in which the drive substrate is provided with a pixel array portion, a drive circuit portion, a conductive guard ring belt surrounding the both, a terminal portion for external connection provided the outside thereof, a wiring which connects the terminal portion provided outside to the drive circuit portion provided inside across the guard ring belt, characterized in that the guard ring belt includes a small area portion and a large area portion which are electrically separated from each other by a slit; and in that the small area portion is provided between the large area portion and the wiring and functions as a buffer region for electrostatic charge.

[Claim 2] The display device according to claim 1, characterized in that the large area portion is electrically subdivided by an additional slit to realize dispersion of charge.

[Claim 3] The display device according to claim 1, characterized in that the electrooptical substance layer is formed of liquid crystal; rubbing treatment is performed on a surface of the drive substrate in order to control orientation of liquid crystal; and the small area portion functions as a buffer region for protecting the wiring from static electricity charged in the large area portion at least due to rubbing treatment.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention] The present invention relates to an active matrix type

display device. In particular, the present invention relates to a structure of a guard ring belt surrounding a pixel array portion and a drive circuit portion which are integrated on a substrate.

[0002]

[Conventional Art] A general structure of a conventional display device is briefly described with reference to FIG. 4. As shown in the figure, the display device has a panel structure provided with a drive substrate 101, a counter substrate 102, and an electrooptical substance layer 103 held between both substrates. As the electrooptical substance layer 103, a liquid crystal material and the like are widely used. A pixel array portion 104 and a drive circuit portion are integrated on the drive substrate 101. The drive circuit portion is divided into a vertical drive circuit 105 and a horizontal drive circuit 106. In addition, a terminal portion 107 for external connection is formed at an upper end of a peripheral portion of the drive substrate 101. The terminal portion 107 is connected to the vertical drive circuit 105 and the horizontal drive circuit 106 through wirings 108.

[0003]

[Problem to be Solved by the Invention] FIG. 5 is a pattern plan view of a drive substrate. In general, a conductive guard ring belt 109 is formed along a peripheral portion on a surface of the drive substrate and surrounds a pixel array portion and a drive circuit portion (not shown) provided inside. In order to connect terminal portions 107a, 107b, and 107c provided outside the guard ring belt 109 and the drive circuit portion provided inside to each other, wirings 108a, 108b, and 108c are patterned so as to cross the guard ring belt 109. The guard ring belt 109 is formed in a window frame shape and provided along a seal region which attaches a pair of the drive substrate and a counter substrate to each other. The guard ring belt 109 is formed of a metal film such as aluminum and shades external incident light so as to surround the pixel array portion. In addition, the guard ring belt 109 is provided so as to fill gaps of the wirings 108a, 108b, and 108c, and planarizes the surface of the drive substrate along the seal region.

[0004] The guard ring belt 109 is formed in an electrically floating state on the surface of the drive substrate having an insulating property, so that static electricity tends to be charged. The guard ring belt 109 has a relatively large area and stores a large amount

of static electricity in a manufacturing process. Therefore, there is a problem in that discharge is generated between the adjacent wirings 108a and 108c in a manufacturing process and electrostatic damage tends to affect the surroundings. For example, by discharge between the guard ring belt 109 and the wirings 108a and 108c, short-circuit fault or the like of an input protection circuit connected to each wiring is caused. Electrostatic damage tends to be generated in the wirings 108a and 108c adjacent to the guard ring belt 109 having a large area, and the wiring 108b is not much affected.

[0005]

[Means for Solving the Problem] In view of the foregoing problem of the conventional art, an object of the present invention is to prevent electrostatic damage around a terminal for external connection due to charge of a guard ring belt. The following measures were taken to achieve such a purpose. That is, a display device according to the present invention basically has a panel structure provided with a drive substrate, a counter substrate, and an electrooptical substance layer held between both substrates. A pixel array portion and a drive circuit portion are integrated on the drive substrate. In addition, a conductive guard ring belt surrounding the both and a terminal portion for external connection provided the outside thereof are formed. Further, a wiring which connects the terminal portion provided outside to the drive circuit portion provided inside is formed across the guard ring belt. A feature of the present invention is that the guard ring belt includes a small area portion and a large area portion which are electrically separated from each other by a slit. The small area portion is provided between the large area portion and the wiring, and functions as a buffer region for electrostatic charge. Preferably, the large area portion is electrically subdivided by an additional slit to realize dispersion of charge. In a mode in which the present invention is embodied, the electrooptical substance layer is formed of liquid crystal, for example, and rubbing treatment is performed on a surface of the drive substrate in order to control orientation of liquid crystal. In such a structure, the small area portion functions as a buffer region for protecting the wiring from static electricity charged in the large area portion at least due to rubbing treatment.

[0006]

[Operation] According to the present invention, the guard ring belt is electrically divided into the small area portion and the large area portion by the slit. This slit is

provided near the wiring which connects the terminal portion provided outside and the drive circuit portion provided inside to each other, and as a result, the small area portion is provided between the large area portion and the wiring. Static electricity charged in the large area portion of the guard ring belt in a manufacturing process is discharged to the adjacent small area portion, and a possibility that the static electricity is discharged to the wiring beyond the small area portion is extremely low. Therefore, a fear that the wiring sustains electrostatic damage is significantly decreased. On the other hand, the small area portion sustains electrostatic damage by discharge; however, the small area portion is in a floating state in the first place; thus, operation of the display device itself is not adversely affected. That is, the small area portion functions as a buffer region for protecting the wiring and the like around the terminal portion for external connection from static electricity charged in the large area portion of the guard ring belt.

[0007]

[Embodiment] Hereinafter, a preferred embodiment of the present invention is described in detail with reference to drawings. FIG. 1 is a schematic plan view showing one embodiment of a display device according to the present invention. In general, the display device has a panel structure provided with a drive substrate, a counter substrate, and an electrooptical substance layer held between both substrates. FIG. 1 shows only a plane pattern of the drive substrate 1 in particular in order that the present invention can be easily understood. The pixel array portion 2 and the drive circuit portion are integrated on the drive substrate 1. The drive circuit portion includes the vertical drive circuit 3 and the horizontal drive circuit 4. In addition, the conductive guard ring belt 5 is patterned along the periphery of the drive substrate 1. The guard ring belt 5 has a window frame shape and is patterned so as to surround the pixel array portion 2 and the drive circuit portions (3 and 4). The guard ring belt 5 is formed of a metal film such as aluminum or aluminum alloy and shades the periphery of the pixel array portion 2 from light. In addition, the guard ring belt 5 is in an electrically floating state over the drive substrate 1 having an insulating property. A plurality of terminal portions 6 for external connection is formed in an upper portion of the outside of the guard ring belt 5. In addition, a wiring 7 which connects the terminal portion 6 provided outside to the drive circuit portions (3 and 4) provided

inside is also formed across the guard ring belt 5. The figure schematically shows five terminal portions 6 and five wirings 7 corresponding thereto; however, ten or more terminal portions 6 are actually provided, and predetermined power supply voltage, clock signal, video signal, and the like can be supplied to the vertical drive circuit 3 and the horizontal drive circuit 4.

[0008] As shown in the figure, each wiring 7 is provided so as to cross the guard ring belt 5, and the guard ring belt 5 is divided along a path of each wiring 7. In this part, the divided guard ring belt 5 fills gaps of the wirings 7 and planarizes a surface of the drive substrate 1.

[0009] A feature of the present invention is that the guard ring belt 5 includes the small area portion 9 and the large area portion 10 which are electrically separated from each other by the slit 8. The small area portion 9 is provided between the large area portion 10 and the wiring 7, and functions as a buffer region for electrostatic charge. That is, static electricity charged in the large area portion 10 of the guard ring belt 5 in a manufacturing process is easily discharged to the adjacent small area portion 9, and a possibility that the static electricity is discharged to the wiring 7 beyond the small area portion 9 is extremely low. Therefore, electrostatic damage around the terminal portion 6 can be significantly prevented. For example, short-circuit fault or the like of an input protection circuit provided corresponding to the terminal portion 6 can be effectively prevented. On the other hand, electrostatic damage is caused to the small area portion 9 by discharge from the large area portion 10; however, the small area portion 9 is in a floating state in the first place; thus, operation of the drive substrate 1 is not adversely affected. Note that as easily understood from the figure, two wirings at opposite ends, which are nearest to the guard ring belt 5, among a plurality of wirings 7 easily sustain electrostatic damage, whereas three wirings 7 provided at the center, which are distant from the guard ring belt 5, have little possibility of sustaining electrostatic damage in the first place. Therefore, as a buffer region for the two wirings 7 provided at the opposite ends, two small area portions 9 are provided on a left end side and a right end side in this example. That is, in the present invention, provision of at least two small area portions 9 is an essential component.

[0010] A structure of the pixel array portion 2 is described for reference. As shown in the figure, gate lines 11 in rows and data lines 12 in columns are arranged so as to

cross to each other. A thin film transistor 13 is formed at an intersection point of each gate line 11 and data line 12. A pixel electrode 14 is also formed. A gate electrode of each thin film transistor 13 is connected to the corresponding gate line 11, a source electrode is connected to the corresponding data line 12, and a drain electrode is connected to the corresponding pixel electrode 14. The gate lines 11 along the rows are connected to the vertical drive circuit 3, whereas the data lines 12 along the columns are connected to the horizontal drive circuit 4. The vertical drive circuit 3 operates in accordance with a clock signal supplied from the terminal portion 6 for external connection, and line-sequentially scans the gate lines 11. Thus, the thin film transistors 13 become conductive per row. On the other hand, the horizontal drive circuit 4 operates in accordance with a clock signal supplied from the terminal portion 6 for external connection, and samples a video signal also supplied from the terminal portion 6 for external connection to each data line 12. The sampled video signal is written to the pixel electrode 14 through the thin film transistor 13 in a conductive state, and a desired image display is performed.

[0011] FIG. 2 is a schematic plan view showing another embodiment of a display device according to the present invention. A basic structure is similar to the embodiment shown in FIG. 1, and corresponding reference numerals refer to corresponding parts in order to be easily understood. A different point is that the large area portion 10 of the guard ring belt 5 is electrically subdivided by additional slits 15 to realize dispersion of charge. In this example, the large area portion 10 having a U-shape is divided into five portions by four additional slits 15. Thus, the absolute amount of static charge stored in each of the subdivided large area portions 10 is small, so that electrostatic damage can also be decreased.

[0012] FIG. 3 shows a cross-sectional structure of a display device according to the present invention. As shown in the figure, the display device has a panel structure provided with the drive substrate 1 on a lower side, a counter substrate 21 on an upper side, and an electrooptical substance layer 22 held between both substrates. As the electrooptical substance layer 22, twisted nematic liquid crystal and the like are widely used. The drive substrate 1 and the counter substrate 21 are attached to each other by a sealant 23. As described above, a pixel array portion, a drive circuit portion, and the guard ring belt 5 surrounding the both are formed on an inner surface of the drive

substrate 1. In the figure, only one thin film transistor 13 and the corresponding pixel electrode 14 included in the pixel array portion are shown. On the other hand, a counter electrode 24 is formed on an inner surface of the counter substrate 21.

[0013] In the thin film transistor 13, a semiconductor thin film 25 patterned into a predetermined shape is considered as an element region, and a gate electrode G is patterned over the semiconductor thin film 25 with a gate insulating film 26 interposed therebetween. This gate electrode G is formed of part of the gate lines 11 shown in FIG. 1. The thin film transistor 13 having such a structure is covered with an interlayer insulating film 27. The pixel electrode 14 is patterned over this interlayer insulating film 27 and connected to a drain region of the thin film transistor 13. The data line 12 is also formed and connected to a source region of the thin film transistor 13.

[0014] The guard ring belt 5 is patterned into a window frame shape along the periphery of the drive substrate 1 so as to surround the pixel array portion 2 and the like provided inside. The guard ring belt 5 is formed of a metal film such as aluminum or aluminum alloy and formed over the interlayer insulating film 27. The guard ring belt 5 is in an electrically floating state, and static electricity is easily stored. For example, in the case where a liquid crystal material is used as the electrooptical substance layer 22, rubbing treatment is performed on the inner surface of the drive substrate 1 in order to control orientation of liquid crystal. This rubbing treatment is such that a substrate surface is rubbed in a certain direction by cotton cloth or the like, and a large amount of static electricity is generated and stored in the guard ring belt 5. In view of this point, in the present invention, the guard ring belt 5 is divided into the small area portion and the large area portion as described above. The small area portion is provided between the wiring connected to the terminal for external connection and the large area portion. A large amount of static electricity charged in the large area portion due to rubbing treatment is discharged to the small area portion, and electrostatic damage to the wiring is prevented. Note that cause of electrostatic charge in a manufacturing process is not limited to rubbing treatment, and the small area portion provided in this guard ring belt forms a buffer region effective in all kinds of charge.

[0015]

[Effect of the Invention] As has been described above, according to the present invention, the guard ring belt includes the small area portion and the large area portion

which are electrically divided by the slit, and the small area portion is provided between the large area portion and a connection wiring and functions as a buffer region for electrostatic charge. Thus, the periphery of the connection wiring can be effectively protected from static electricity charged in the guard ring belt in a manufacturing process, and significant improvement in yield can be achieved.

[Brief Description of the Drawings]

[FIG. 1] is a schematic plan view showing one embodiment of a display device according to the present invention.

[FIG. 2] is a schematic plan view showing another embodiment of a display device according to the present invention.

[FIG. 3] is a schematic cross-sectional view showing a panel structure of a display device according to the present invention.

[FIG. 4] is a schematic perspective view showing a structure of a general display device.

[FIG. 5] is a schematic plan view showing a pattern structure example of a conventional display device.

[Description of the Numerals]

1 drive substrate
2 pixel array potion
3 vertical drive circuit
4 horizontal drive circuit
5 guard ring belt
6 terminal portion
7 wiring
8 slit
9 small area portion
10 large area portion
11 gate line
12 data line
13 thin film transistor
14 pixel electrode

15 additional slit

21 counter substrate

22 electrooptical substance layer

23 sealant

24 counter electrode